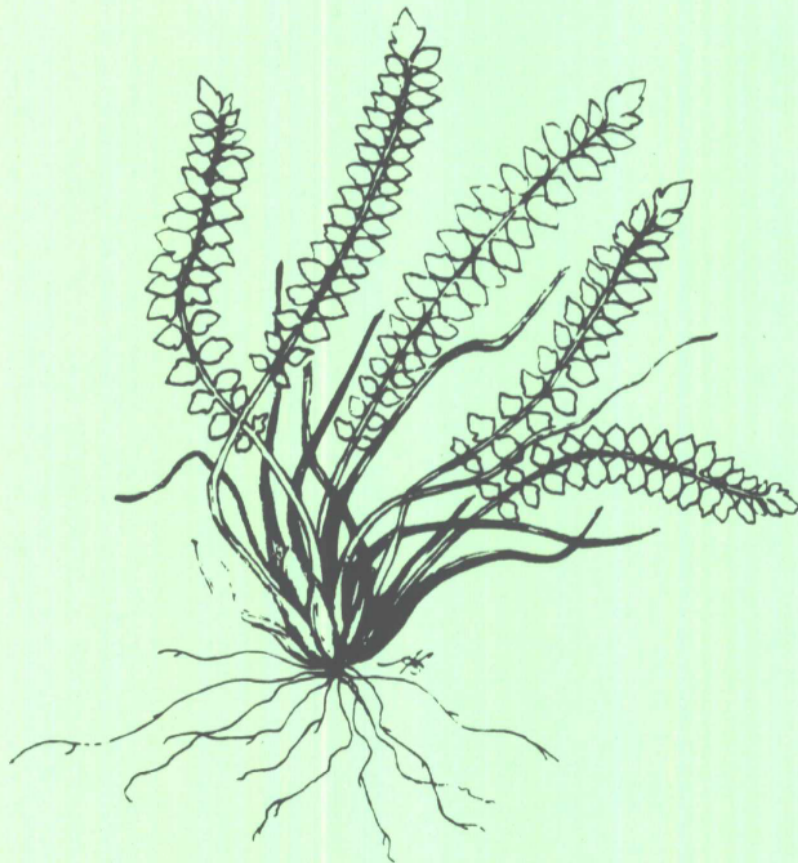


ALEUTIAN SHIELD FERN

Polystichum Aleuticum

RECOVERY PLAN



ALEUTIAN SHIELD FERN

(Polystichum aleuticum C. Chr. in Hultén)

RECOVERY PLAN

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for

Region 7
U.S. Fish and Wildlife Service
Anchorage, Alaska

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Date:

9/30/92

This is the completed Aleutian Shield Fern Recovery Plan. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions of cooperating agencies and does not necessarily represent the views of all who played a role in preparing this plan. It has been prepared by the U.S. Fish and Wildlife Service to delineate reasonable actions which are believed to be required to recover and/or protect the species. This plan is subject to modification as dictated by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

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EXECUTIVE SUMMARY
ALEUTIAN SHIELD FERN RECOVERY PLAN

Current Status: An extremely narrow endemic plant with a population numbering approximately 112 individuals, this species was listed as endangered in 1988. It is presently known to occur only on Adak Island, Aleutian Islands, Alaska.

Habitat Requirements and Limiting Factors: The Aleutian shield fern is presently known to occur on steep, rock-outcrop areas on the upper slopes of Mt. Reed, Adak Island. All known occupied habitat occurs on a military reservation managed by the U.S. Fish and Wildlife Service as part of the Alaska Maritime National Wildlife Refuge. The causes of its rarity are poorly understood and may be natural. It has been suggested that grazing by introduced ungulates may constitute a threat to the species.

Recovery Objective: Protect existing population and habitat.

Recovery Criteria: Pending additional information, downlisting could be considered only if significant new populations are discovered. A greenhouse population of a minimum of 1,000 mature sporophytes should be maintained and genetic material should be stored in a germplasm repository. The extant population should be protected from disturbance by humans and introduced ungulates.

Actions Needed:

1. Protect population and manage the habitat.
2. Conduct research on the biology of the species.
3. Search for additional populations.

Recovery Costs (\$000):

<u>Year</u>	<u>Need 1</u>	<u>Need 2</u>	<u>Need 3</u>	<u>Total</u>
1993	14	22	9	45
1994	16	28	11	55
1995	5	29	17	51
1996	5	12	11	28
1997	5	12	17	34
<u>Total</u>	45	103	65	213

Date of Recovery: No recovery date can be projected at this time.

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I. INTRODUCTION

The Aleutian shield fern (Polystichum aleuticum) was listed as an endangered plant on February 17, 1988 (53 FR 4626). This recovery plan summarizes current knowledge of the taxonomy, former and current distribution, and biology of the species. Also presented are recommendations for a program to secure and monitor the existing known population, to survey for new locations, and to continue conducting biological research. Reclassification of the species to threatened status may be appropriate if significant new wild populations are discovered, but it is not likely that this rare endemic could be de-listed in the foreseeable future.

Description and Taxonomy

Polystichum aleuticum was first described by Christensen (Hultén 1936, Christensen 1938) from the original specimen collected by W.J. Eyerdam at Atka Island in 1932. A member of the family Polypodiaceae, it is also called the Aleutian holly fern. The following description is derived from Hultén 1968, Lipkin 1985, Murray and Lipkin 1987, and Smith and Davison 1988. P. aleuticum is a small, tufted, solitary fern from a stout rhizome with many chestnut-brown old stipe bases. The fronds, present only during the growing season, grow to 15 centimeters (six inches) long, are dark green to olive green in color, gradually tapering above and below the middle. The leaf blades (fronds) are divided into overlapping, ovate segments (pinnae), incised with short bristle tips. Straw-colored scales are sparingly to abundantly distributed along the main leaf axis and especially on the under-surface of

leaf segments. The spore masses are aggregated into 6-8 patches (sori) forming two rows on the under-surface of leaf segments.

P. aleuticum is a well-marked and extremely narrow endemic which is not closely related to any other species in North America. Its only close affinities are with taxa of Himalayan-Sino-Taiwan-Japan distribution. Although its taxonomic relationship to other species has not been determined, P. aleuticum appears most closely related to P. lachenense, a species distributed from the Himalaya eastward on several high mountains of central China, Taiwan, and northern Japan (Smith and Davison 1988).

Distribution

Polystichum aleuticum is only known from Atka (Figure 1) and Adak (Figure 2) Islands in the Andreanof group (Central Aleutian District) of the Aleutian Islands. Only general information is available on the location [mountains southeast of the village] of Eyerdam's 1932 type collection on Atka Island (Hultén 1936), which is the only known occurrence of the fern on Atka. His annotation "very rare" constitutes the only available information on the status of the Atka population at that time (Lipkin 1985). Recent attempts to find P. aleuticum on Atka have been unsuccessful (Friedmen 1984, Lipkin 1985, Smith and Davison 1988, 1990).

P. aleuticum was first discovered on Adak Island by D. K. Smith (1985) in 1975 on the upper slopes of Mt. Reed (Smith 1985), three miles southwest of the Adak Naval Air Station. The fern was not observed on Adak Island again until

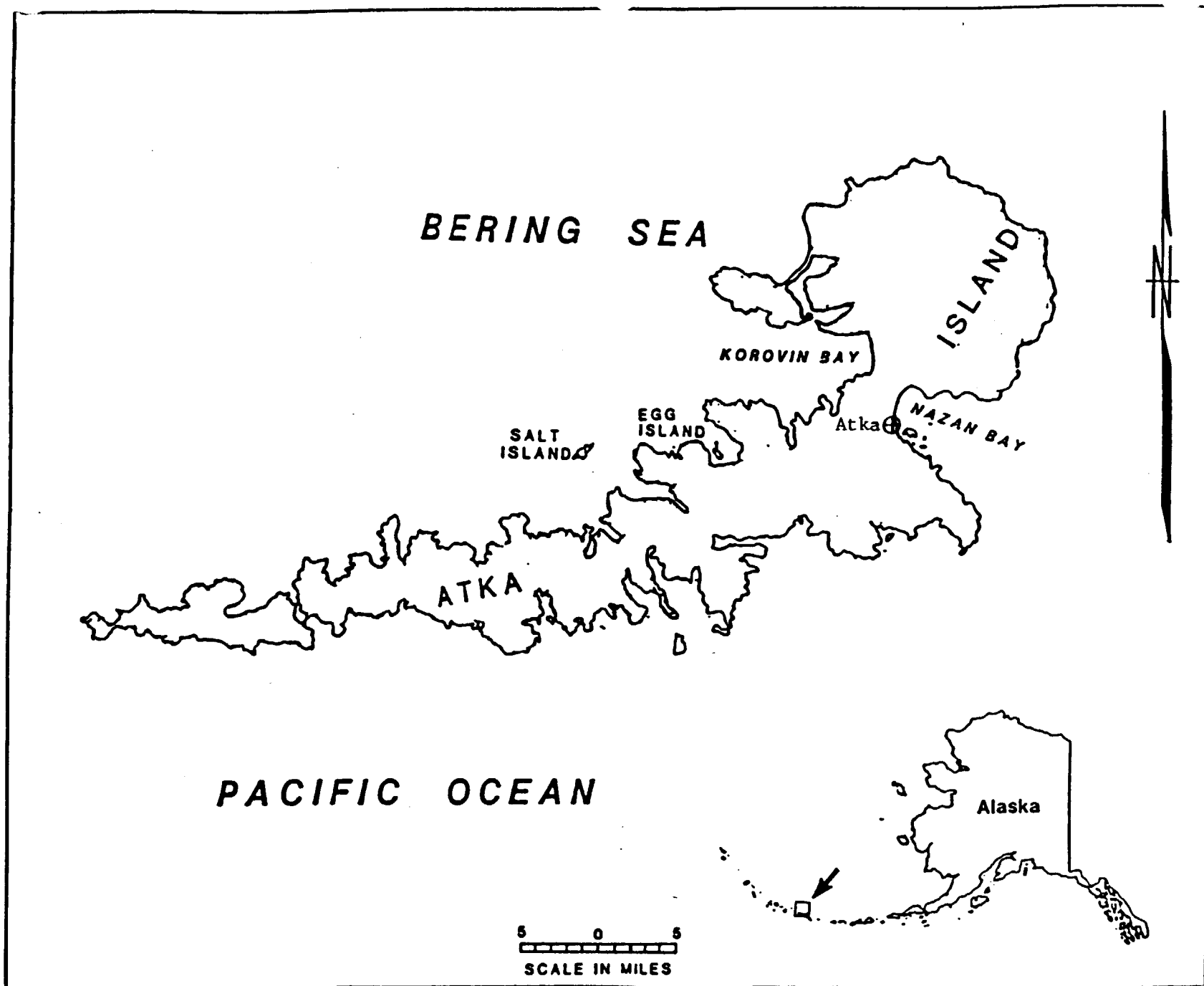
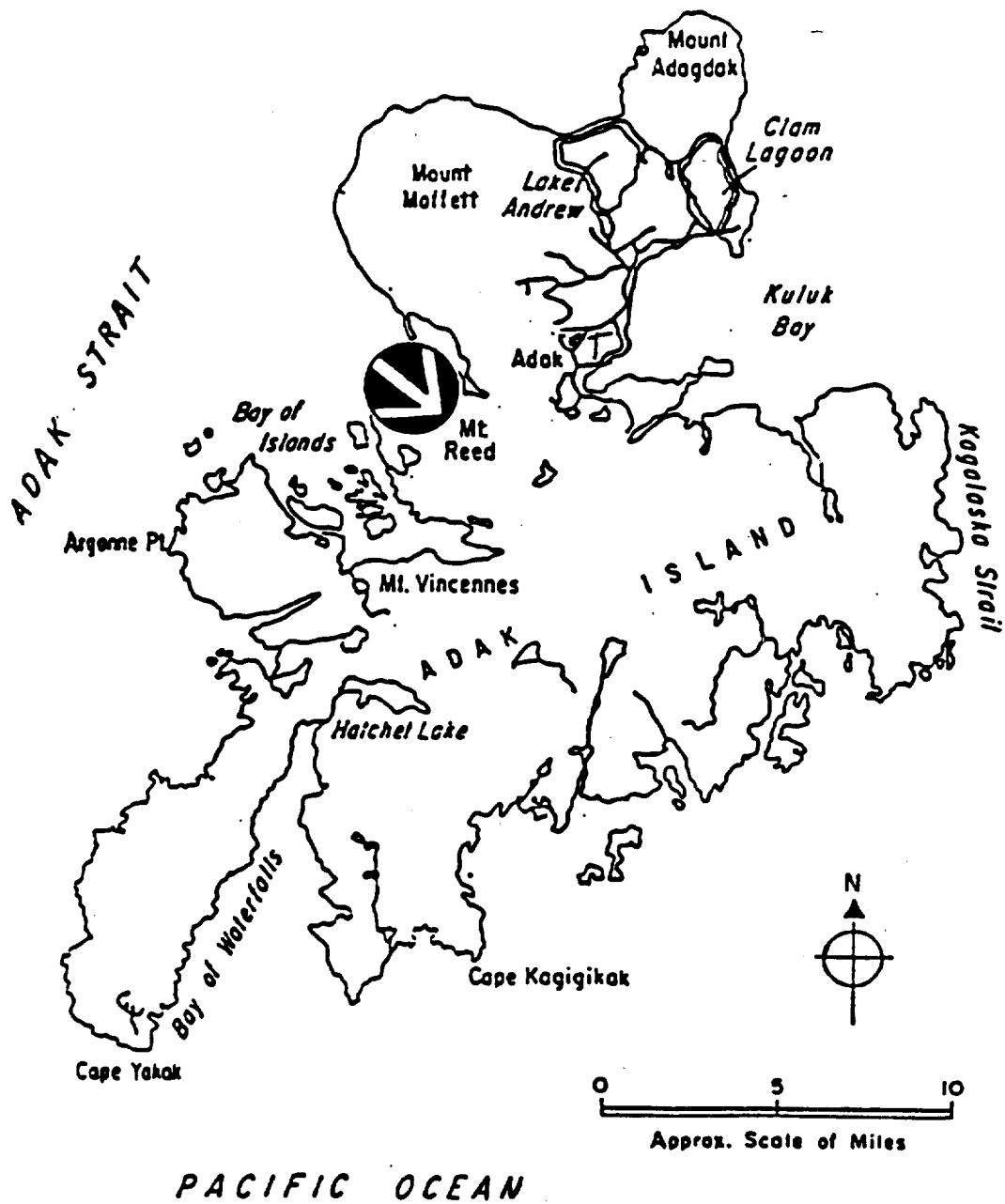


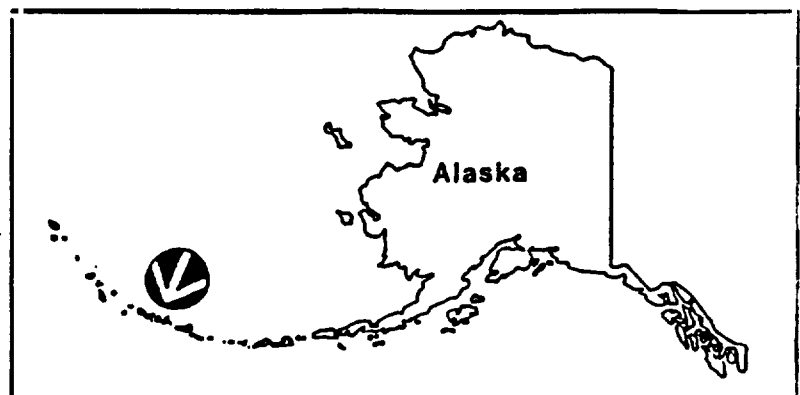
Figure 1. Map of Atka Island

BERING SEA



PACIFIC OCEAN

Figure 2. Map of Adak Island showing the location of Mt. Reed



1987, when Smith (1987) observed seven "clumps" on Mt. Reed, probably in the same location as the 1975 discovery (D. K. Smith, University of Tennessee, pers. comm. 1992). Surveys at other sites on Adak Island which appeared to have characteristics similar to the known shield fern habitat, have failed to record additional populations.

The current known population of P. aleuticum consists of approximately 112 plants occupying a total area of approximately 0.1 hectare (0.25 acre) on the northeast arm of Mt. Reed, Adak Island (Tande 1989). The majority of the population (98 plants) are within a 600 m² (6,400 ft²) area, with the remaining 14 plants growing in a 40 m² (400 ft²) area 500 m (1,650 ft) to the north.

No information is available on the former distribution of P. aleuticum. It has been suggested that the fern is a relict surviving from Tertiary or early Pleistocene times. Its presence in only the Andreanof Islands group (which formed a single, large island during maximum glaciation) suggests it may have survived on a nunatak or refugium in that area and has apparently not expanded its range (Lipkin 1985).

Habitat

Mt. Reed is an ancient volcanic mountain approximately 550 m (1,800 ft) in elevation with three "arms" extending northeast, southeast, and west. The topography of Mt. Reed is typical of mountains in the older, southern parts of the Aleutian Islands. These mountains have weathered more than the younger

volcanoes, were heavily glaciated, and now form steep (50-75 deg.), rugged ridges (Lipkin 1985). The substrate is composed of exposed, weathered basaltic and pyroclastic rock outcrops with rooting substrate confined to fissures, crevices, and thinly mantled horizontal ledges. Polystichum aleuticum is found on the northeast arm of Mt. Reed on southeast- to east-facing slopes 457-526 m (1,500-1,725 ft) in elevation. Most individuals grow in clumps at the edge of vegetation mats along rock walls and on the edges of sod mats that cap rocks (Tande 1989).

Adak's climate is characterized by mild temperatures, and dense fog blankets the habitat on Mt. Reed during summer months. Clear skies are rare. Temperature and precipitation data for the Naval Air Station, Adak (Arctic Environmental and Information Data Center, University of Alaska) indicate mean annual values of 40°F and 68 in/yr, respectively, and a wind speed mean hourly value of 15 mph. These summary data from Adak (recorded near the coast) are only general indicators of the weather at the upper elevations of Mt. Reed which receives colder temperatures, more snow, and higher winds.

P. aleuticum is associated with three vegetation types: (1) dwarf willow-moss type occupying rocky, protected alcoves and cliff ledges under overhanging rock walls; (2) dwarf willow-sedge-moss type in moist but more exposed and better drained mid-to-upper portions of rock gullies; and (3) sedge-anemone-arnica-moss type of moist lower gully/cliff base areas (Alaska Natural Heritage Program 1992). Nine major vegetation types have been identified for the northeast arm of Mt. Reed (Tande 1989).

Limiting Factors and Threats

The causes for the extreme rarity of Polystichum aleuticum are poorly understood but are likely due to natural processes. It has been suggested that the ancestors of P. aleuticum colonized the Aleutian Islands from the west (Kamchatka and Siberia) during the Late Tertiary (Pliocene) period. Although P. aleuticum may once have been more widespread in the Aleutians, episodic glaciation through the Pleistocene likely limited or reduced populations to the extent that only isolated biotypes remain today (Lipkin 1985, Smith 1988).

Another theory is that P. aleuticum arrived post-glacially in the Andreanof Islands from Asia by some form of long-distance dispersal (e.g. wind), and has not expanded its range (D. Murray, University of Alaska, pers. comm. 1992).

Known only from habitat at upper elevations in the remote Aleutian Islands, P. aleuticum is isolated from most human disturbances. Because the Adak shield fern population is located near a military installation of approximately 5,000 people, trampling and unauthorized collecting are potential threats. However, the significance of these threats is reduced by the remote location of the shield fern population, restrictions on visitor access to Adak Island, and protective management by the Alaska Maritime National Wildlife Refuge. Future collecting of P. aleuticum should be authorized only for purposes that advance the recovery effort.

Although introduced ungulates occur on both Atka and Adak Islands, their affect on P. aleuticum is not known. European reindeer were introduced to Atka Island in 1914 and have had a marked impact on the vegetation, especially on the west end of the island (Lipkin 1985, Department of the Interior 1988). Caribou were introduced to Adak Island in 1958 and fall populations approach 500-600 animals currently (V. Byrd, U.S. Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge, pers. comm. 1992). Caribou are adept at foraging in a variety of terrain types, including steep slopes such as those on Adak Island where P. aleuticum is known to occur. Investigations are needed to determine the affect of introduced ungulates on existing and potential shield fern habitat.

With steep terrain and a thin soil layer characterizing the known habitat for P. aleuticum, soil movement (solifluction) is a potential threat to the population. Mass wasting could be encouraged by any of the several hundred seismic events Adak Island experiences each year. D. K. Smith (1987) found one plant clinging to dislodged substrate, and slumping of soils at the Mt. Reed site was noted by G. Tande (1989). Natural instability of the substrate would also be exacerbated by foot traffic from human activity at the site.

Conservation Efforts

Initial research activities for Polystichum aleuticum centered around attempts to relocate previously-identified populations, or searches to discover new locations for the plant. Atka (the type locality) and Adak Islands have received the highest priority and the majority of effort. Surveys have been

conducted on five other islands considered likely prospects, or where sighting reports were received: Attu, Kiska, Rat, Unalaska, and Kagalaska. Table 1 summarizes field activities through 1991.

Table I. Summary of Field Surveys for Polystichum aleuticum.

<u>Year</u>	<u>Island(s)</u>	<u>Investigator</u>	<u>Results</u>
1932	Atka	W. Eyerdam (Hultén 1936)	Collected type specimen
1975	Adak	D. Smith (1985)	Discovers <u>P. aleuticum</u> pop.
1977	Adak	M. Williams (1978)	Unsuccessful
1983	Atka	B. Friedman (1984)	Unsuccessful
1984	Adak, Atka	R. Lipkin (1985)	Unsuccessful
1985	Adak, Kiska, Rat	S. Talbot (1986)	Unsuccessful
1987	Adak	D. Smith (1987)	Re-discovers pop.
1988	Adak, Attu	S. Talbot (pers. comm. 1988)	Discovers second Adak loc, Unsuccessful (Attu)
1988	Adak, Unalaska, Kagalaska	R. Lipkin K. Kincheloe (1988)	Unsuccessful (Unalaska, Kagalaska), Maps Adak pop.
1988	Adak, Atka	D. Smith P. Davison (1988)	Unsuccessful (Atka)
1989	Adak	G. Tande (1989)	Maps Adak pop. No new pop.
1990	Adak, Atka	D. Smith P. Davison (1990)	Unsuccessful (Atka)
1991	Adak	R. Lipkin (in prep.)	Monitors Adak pop. No new pop.

The Mt. Reed population was surveyed and thoroughly mapped by Tande (1989), who also established permanent plots to allow for future systematic

monitoring. Baseline data compiled for each plot included the vegetation type, status, number and position of individuals in the plot, and a photographic record. In 1989 Tande found the plants to be healthy and vigorous, and well secured to the substrate. During 1991, R. Lipkin (in prep.) conducted the first monitoring of the Mt. Reed population since establishment of the permanent plots and found that the population was stable.

Many questions remain concerning the reproductive biology and causes of rarity for *P. aleuticum*. The U.S. Fish and Wildlife Service contracted with the Agriculture and Forestry Experiment Station of the University of Alaska Fairbanks to conduct experiments on propagation of *P. aleuticum*. Ten spore-bearing fronds (from different plants) from the Mt. Reed population were collected each year for three years beginning in 1989. The material was transported to the lab in Fairbanks, Alaska, where the first successful germination of *P. aleuticum* was achieved during November 1989 (Holloway 1990). By February 1992 the greenhouse population had grown to contain 1,476 sporophytes. Although 1,200 of the sporophytes had advanced to well-developed fronds, no plants had developed spores (Holloway 1992).

Research has also been initiated to investigate aspects of reproductive biology through genetic analysis, to determine the feasibility of storing germplasm (spores) over the long term, and to determine the feasibility of transplanting greenhouse-raised *P. aleuticum* to the wild.

II. Recovery

Objectives

The primary objective of the Aleutian Shield Fern Recovery Plan is to protect and maintain the existing known population of Polystichum aleuticum, and its habitat on Mt. Reed, Adak Island, Alaska. Until additional information is obtained on the causes of rarity and the potential for recovery, no precise recovery goal can be set for re-classification to threatened status. However, consideration for re-classification to threatened status could result from the discovery of additional populations. Many areas remain to be surveyed, but the results of previous field studies indicate that the potential for discovering a large new population is remote. The extant population of P. aleuticum inhabits only a small area on Mt. Reed and is subject to the threat of earth slides or other unpredictable events. Therefore, it is unlikely that P. aleuticum could be de-listed in the foreseeable future.

Protecting and monitoring the extant population, conducting research on artificial propagation and reproductive biology, and surveys for new populations are the main elements of the recovery effort. Re-introduction of P. aleuticum to the wild using greenhouse-raised plants is not planned initially, however it would be valuable to determine the feasibility of such a re-introduction following successful artificial propagation.

Narrative

I. Protect existing population

The only known population of P. aleuticum contains approximately 112 plants occupying a total area of approximately 0.1 hectare on the north-east arm of Mt. Reed, Adak Island.

A. Map known population

This task was completed in 1989

B. Develop a management plan

A management plan should be developed which addresses protection and monitoring of the Mt. Reed population and others that might be discovered. The plan should expand upon protective measures already in place through refuge regulations, such as the prohibition of unauthorized plant collecting on refuge lands. This plan should address restrictions on access, frequency and timing of population monitoring, and contingency actions to be taken if a catastrophic event occurs (e.g., landslide).

C. Implement management plan

As managers of the Aleutian Islands Unit of the Alaska Maritime National Wildlife Refuge, the Adak refuge headquarters is the most appropriate organization for implementing the management plan. It is highly desirable that experienced personnel conduct on-site investigations in order to minimize disturbance and provide for consistency in observations.

II. Investigate impacts of introduced ungulates

Grazing by introduced ungulates is considered a potential threat to P. aleuticum populations on Atka and Adak islands. An assessment of grazing pressure on existing and potential P. aleuticum habitat should be undertaken.

A. Adak Island

Caribou were introduced to Adak Island in 1958 and the fall population now numbers between 500-600 animals. Hunting helps keep this population within the carrying capacity of the habitat. Caribou have been regularly observed on Mt. Reed, and grazing pressure in the vicinity of the P. aleuticum population should be assessed. If it is determined that caribou constitute a threat to the existing population, protective measures should be instituted.

B. Atka Island

European reindeer were introduced to Atka Island in 1914 and are now thought to be having a marked impact on native vegetation of the island. Although originally introduced as a food source for island residents, much of the western end of the island is difficult to access for hunting, and reindeer numbers have grown unchecked. No current estimate of the reindeer population is available. An assessment of the impacts of reindeer grazing to potential shield fern habitat should be conducted.

III. Conduct research on reproductive biology

Many questions remain regarding the reproductive biology of P. aleuticum. Research into artificial propagation and genetic analysis will hopefully provide information on the causes of rarity and potential for recovery.

A. Conduct experiments in artificial propagation

Research on in-vitro cultivation began in 1989 when the first successful germination was accomplished. Reproductive material for propagation experiments was collected from the Mt. Reed population during 1989-91. Investigators should continue experiments to determine optimal and acceptable environmental parameters including growth media, soil pH, photoperiod, temperature, pests, etc. Only plants and materials which are the product of artificial propagation should be used for destructive sampling.

B. Conduct genetic analysis

Utilize current technologies such as allozyme electrophoresis to determine information about reproductive biology and genetic purity of the Mt. Reed population as it might relate to possible causes of rarity. In addition, investigate the taxonomic relationships of P. aleuticum by comparing genetic variation among other closely related taxa such as P. lachenense.

IV. Establish a greenhouse population

A greenhouse population should be maintained to provide a reserve gene pool in case of catastrophic losses to the the wild population, and to provide material for research and education purposes. During 1992, the greenhouse population contained nearly 1,500 sporophytes, but no mature plants.

A. Collect reproductive material from the Mt. Reed population

This task was completed in 1991.

B. Maintain greenhouse population

A minimum greenhouse population of 1,000 mature plants should be maintained while artificial propagation methods are being refined, or

when there is a need for greenhouse-raised plants for re-introduction or research purposes.

V. Establish/contribute to a germplasm repository

Because of the relict and tenuous status of P. aleuticum, representative genetic material should be preserved in a repository.

A. Determine the viability of spores during storage

Experiments should be conducted to determine how long and under what conditions spores will remain viable during storage, and to determine if replenishment imposes a risk to the natural, source population.

B. Contribute to a germplasm repository

Spores should be contributed to a germplasm repository, and replenished on a regular basis. Facilities considered should specialize in the storage of spore material. Those currently considered as potential sites include the National Fern Foundation and the Center for Plant Preservation.

VI. Investigate the feasibility of re-introduction

Although supplementing the natural reproduction is not presently considered a necessary recovery action, a determination should be made whether or not artificially-propagated P. aleuticum could be transplanted to natural habitat. This experiment should be initiated after the greenhouse population is well established.

A. Conduct experimental plantings

Plots should be established in the field to test the ability of greenhouse-raised plants to adapt to natural conditions. Adak Island is the most likely location for these plots because of the relative ease at which they could be established and monitored.

1. Establish a nursery

Establish a nursery at the refuge headquarters in Adak for one-two seasons in order to test the hardiness of greenhouse-raised specimens.

2. Establish re-introduction test plots

Re-introduction test plots should be established along a substrate/environmental gradient on Adak Island.

VII. Conduct systematic surveys for additional populations

The discovery of additional populations of Polystichum aleuticum provides the best opportunity for re-classification to threatened status. Although surveys

have been conducted on parts of Adak, Atka, Unalaska, Kagalaska, Kiska, Rat, and Attu Islands, much potential habitat remains to be explored.

A. Develop a survey plan

This plan should include a prioritized list of potential areas to be surveyed, and a protocol for opportunistic surveys of any potential shield fern habitat.

B. Conduct Surveys

1. Adak Island

Mt. Reed has the highest probability for discovery of additional discrete population groups. Additional surveys are needed on Mt. Reed and other locations on the island; especially the Lake Betty basin, Gannet Pass, and areas farther west.

2. Atka Island

Atka Island is the original type location for P. aleuticum, and attempts to re-discover the plant here should continue. Recent surveys have been concentrated on the east end of the island, near the village of Atka, in areas accessible by foot and small boat. Efforts should be made to survey farther west, at least to the vicinity of Sarana Cove.

3. Other islands

A prioritized list of islands thought to be potential sites for P. aleuticum should be developed so that surveys can be conducted systematically. All opportunities should be taken to conduct surveys incidental to other field operations on the refuge. Training should be provided to refuge field personnel in the identification of P. aleuticum and its habitat.

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PART III

IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for this recovery program. It is a guide to meet the objectives of the Aleutian Shield Fern Recovery Plan, as elaborated upon in Part II, Narrative Section. This table indicates the priority in scheduling tasks to meet the objectives, which agencies are responsible to perform these tasks, a time-table for accomplishing these tasks, and the estimated cost to perform them. Implementing Part III is the action of the recovery plan, that when accomplished, will satisfy the prime objective. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

- | | |
|--------------|---|
| Priority 1 - | An action that must be taken to prevent extinction or to prevent the species from declining irreversibly. |
| Priority 2 - | An action that must be taken to prevent a significant decline in the species population/habitat quality, or some other significant negative impact short of extinction. |
| Priority 3 - | All other action necessary to provide for full recovery of the species. |

Recovery Plan Implementation Schedule for Aleutian Shield Fern

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST (\$000)	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	Comments
Cost Need 1: Protect the Existing Population											
1	IA	Map the known population		FWS7-AE	0						Completed, 1989
1	IB	Develop management plan	1	FWS7-ARW* FWS7-AE	2 1	2 1					
1	IC	Implement management plan	cont.	FWS7-ARW	25	5	5	5	5	5	
Investigate Impacts of Ungulates											
2	IIA	Adak Island	1	FWS7-ARW* FWS7-AE	5 1	5 1					
2	IIB	Atka Island	1	FWS7-ARW* FWS7-AE	10 1		10 1				
		Subtotal cost need 1			45	14	16	5	5	5	
Cost Need 2: Conduct Biological Research											
2	IIIA	Conduct experiments in artificial propagation	3	FWS7-AE UAF	30	10	10	10			Initiated, 1989 U. Alaska Fairbanks
2	IIIB	Conduct genetic analysis	2	FWS7-AE	10	5	5				Initiated, 1992 U. Alaska Fairbanks
Establish Greenhouse Population											
2	IVA	Collect reproductive material		FWS7-AE* FWS7-ARW	0						Completed, 1991
2	IVB	Maintain greenhouse population	cont.	FWS7-AE	25	5	5	5	5	5	Initiated, 1990 U. Alaska Fairbanks
Preserve Genetic Material											
2	VA	Determine spore viability	3	FWS7-AE	3	1	1	1			Initiated, 1990 U. Alaska Fairbanks

Recovery Plan Implementation Schedule for Aleutian Shield Fern

PRIOR- ITY #	TASK #	TASK DESCRIPTION	TASK DURA- TION (YRS)	RESPONSIBLE PARTY	TOTAL COST (\$000)	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	Comments
2	VB	Contribute to a germplasm repository	cont.	FWS7-AE	5	1	1	1	1	1	
		Investigate Re-introduction Potential									
2	VIA1	Establish nursery	2	FWS7-ARW* FWS7-AE	10 2		5 1	5 1			
2	VIA2	Establish reintro- duction plots	3	FWS7-ARW* FWS7-AE	15 3			5 1	5 1	5 1	
		Subtotal cost need 2			103	22	28	29	12	12	
		Cost Need 3: Conduct Surveys for Additional Populations									
3	VIIA	Develop survey plan	1	FWS7-AE* FWS7-ARW	2 1	2 1					
3	VII B1	Conduct Surveys Adak Island	3	FWS7-AE* FWS7-ARW	15 3	5 1		5 1		5 1	
3	VII B2	Atka Island	2	FWS7-AE* FWS7-ARW	20 2		10 1		10 1		
3	VII B3	Other islands	3	FWS7-AE* FWS7-ARW	20 2			10 1		10 1	
		Subtotal cost need 3			65	9	11	17	11	17	
		Total Yearly Cost			213	45	55	51	28	34	

Cont. = The action will be implemented on an annual basis once the action is begun.

* = Lead Agency

FWS7-AE = U.S. Fish and Wildlife Service, Region 7 Fish and Wildlife Enhancement
FWS7-ARW = U.S. Fish and Wildlife Service, Region 7 Refuges and Wildlife